

56F8300 Digital Power Factor Correction using Processor ExpertTM

Targeting Document

56F8300
16-bit Digital Signal Controllers

8300DPFCTD
Rev. 1
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freescale.com



Document Revision History

Version History	Description of Change
Rev 0	Initial release
Rev 1	Updating format; adding reference to 56F8100 family and 56F8367EVM

Digital Power Factor Correction

This application exercises simple control of the Power Factor Correction (PFC) without motor control on the 56F8346, 56F8357 or 56F8367 EVM board and the EVM Motor Kit.

Applications developed for this demonstration board were not designed for the 56F8100 devices. The 56F8300 demonstration board does, however, fully support 56F8100 software development.

1. Specifications

The Digital PFC application performs power factor correction for 3-Phase AC/BLDC High-Voltage Power Stage hardware without motor drive. This demonstration evaluates the basic algorithm of power factor correction for the current hardware implementation. PFC software was designed for use with motor control applications; the Digital PFC application allows target memory configuration of RAM and Flash.

The input power line must meet the following requirements:

- Input voltage value 115V and 60Hz
- Input voltage value 230V and 50Hz

The applications run at 230V, 50Hz by default. To switch to 115V, 60Hz, comment this line in *Digital_PFC.c*:

```
#define MILESTONE_OFFSET MKS_TO_TICK(570L) //For 50 Hz, 230 V
```

And uncomment this line:

```
//#define MILESTONE_OFFSET MKS_TO_TICK(1498L) //For 60 Hz, 115 V
```

The Digital PFC application may be used in the Manual Operating Mode. The remote control functionality of the PC master software application is not implemented.

The application can run on:

- External RAM
- Flash

1.1 Manual Operating Mode

The PFC conversion is controlled by the RUN/STOP switch (S3); see [Figure 1-1](#). The green USER LED (LED2; see [Figure 1-2](#)) indicates the application states. When the application is ready, the USER LED blinks at a 2Hz frequency.

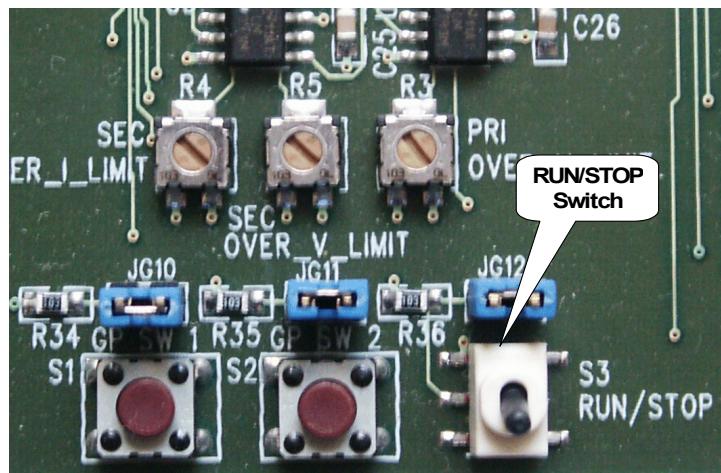


Figure 1-1 RUN/STOP Switch on the Daughter Card

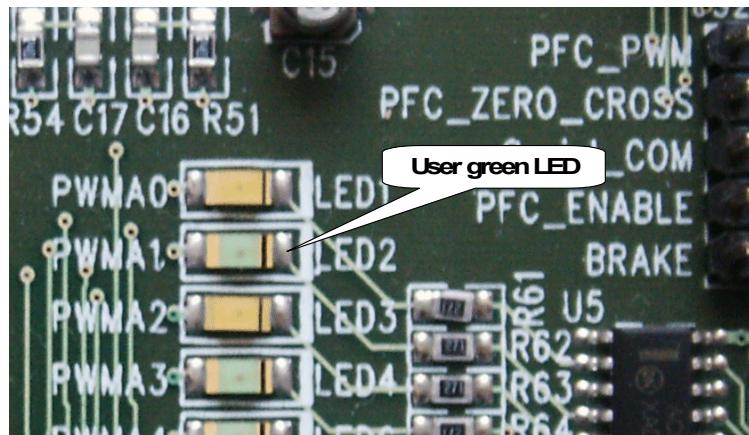


Figure 1-2 USER LED on the Daughter Card

The PFC conversion can be enabled after the RUN/STOP switch is moved to the RUN position. The normal PFC conversion process is indicated by the green USER LED, which will light continuously. To disable PFC conversion, the RUN/STOP switch must be moved to the STOP position.

Table 1-1 Motor Application States

Application State	Digital PFC State	LED State
Stopped	Stopped	Green LED blinking Red LED off
Running	Spinning	Green LED on Red LED off
Fault	Stopped	Green LED off, Red LED on

1.2 PC Master Software (Remote) Operating Mode

The drive is monitored remotely from a PC through the SCI communication channel of the device via an RS-232 physical interface.

PC master software displays the following information:

- Application mode
- Application status
- DCBus Voltage

Application Mode Project files for the PC master software are located in:

`..\pcmaster\sdm_external_memory.pmp`, uses Map file to run in the small memory model of the external memory

`..\pcmaster\ldm_external_memory.pmp`, uses Map file to run in the large memory model of the external memory

`..\pcmaster\sdm_pROM-xRAM.pmp`, uses Map file to run in the small memory model of the internal memory

`..\pcmaster\ldm_pROM-xRAM.pmp`, uses Map file to run in the large memory model of the internal memory

`..\pcmaster\sdm_xROM-xRAM.pmp`, uses Map file to run in the small memory model of the internal memory

`..\pcmaster\ldm_xROM-xRAM.pmp`, uses Map file to run in the large memory model of the internal memory

Start the PC master software window's application, `sdm_external_memory.pmp`. [Figure 1-3](#) illustrates the PC master software control window after this project has been launched.

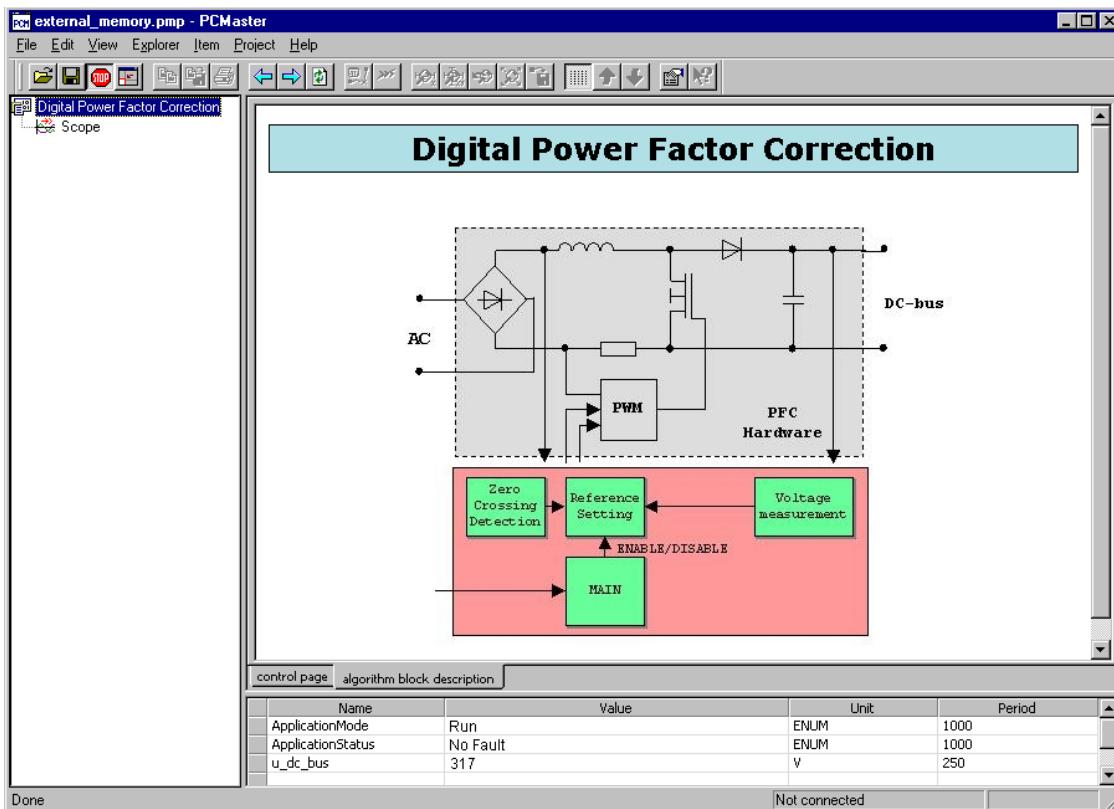


Figure 1-3 PC Master Software Control Window

2. Hardware Set-up

Figure 2-1 illustrates the hardware set-up for the Digital PFC application, which requires a motor drive. The 3-Phase AC/BLDC High-Voltage Power Stage board contains the JP201 jumper that selects the power supply device. Pins 2 and 3 of the JP201 connection correspond to a simple rectifier-capacitor power stage. The PFC hardware set-up requires closing pins 1 and 2 of the JP201 connection; see **Figure 2-2**.

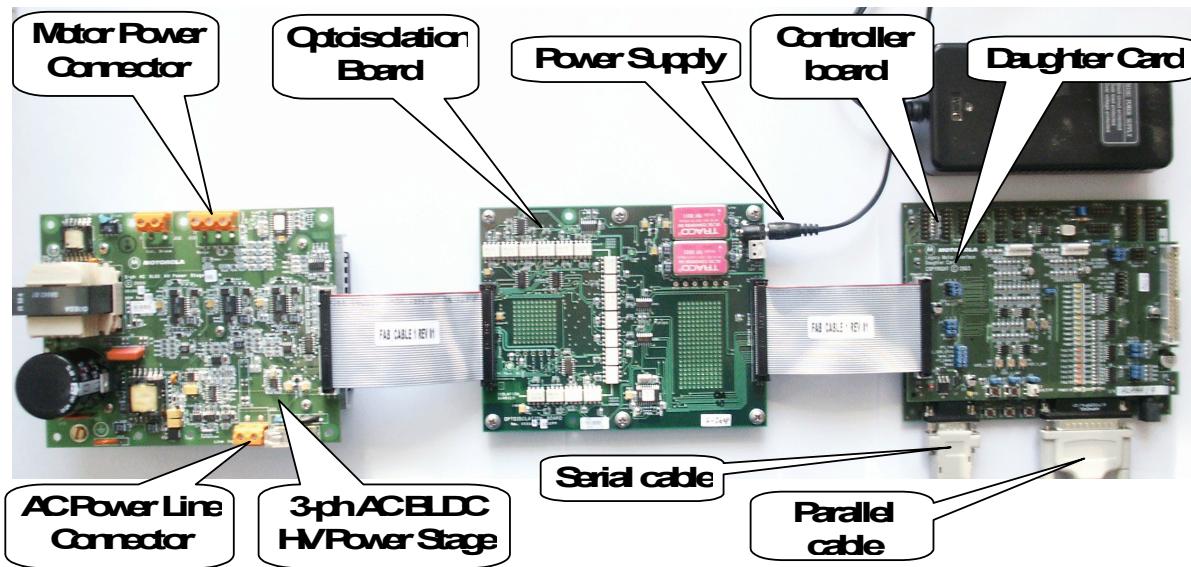


Figure 2-1 Digital PFC Application Set-up

The system is comprised of the following components:

- Controller board for 56F8346, 56F8357 or 56F8367
 - Supplied as 56F8346EVM, 56F8357EVM or 56F8367EVM board
 - Described in **56F8346 Evaluation Module Hardware User's Manual**, **56F8357 Evaluation Module Hardware User's Manual** or **56F8367 Evaluation Module Hardware User's Manual**
- 3-Phase AC BLDC High-Voltage Power Stage, 180W
 - Supplied in a kit with optoisolation board as ECOPTHIVACBLDC
 - Described in **3-Phase Brushless DC High-Voltage Power Stage**
- Optoisolation Board
 - Supplied with 3-Phase AC/BLDC High-Voltage Power Stage as ECOPTHIVACBLDC
or
 - Supplied alone as ECOPT - optoisolation board
 - Described in **Optoisolation Board User's Manual**

Warning: It is strongly recommended that optoisolation (optocouplers and optoisolation amplifiers) be used during development to avoid damage to the development equipment.

Note: Documentation for all components can be found at:
<http://freescale.com>

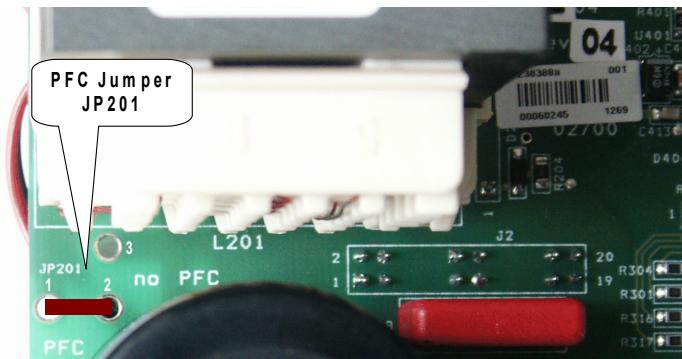


Figure 2-2 Jumper JP201 on the 3-Phase AC BLDC Power Stage

For detailed information, see the **56F8346 Evaluation Module Hardware User's Manual**, **56F8357 Evaluation Module Hardware User's Manual**, or **56F8367 Evaluation Module Hardware User's Manual**. The serial cable is needed for the PC master software debugging tool only.

2.1 EVM Jumper Settings

To execute the Digital PFC application, the daughter card requires the strap settings shown in **Figure 2-3** and **Table 2-1**.

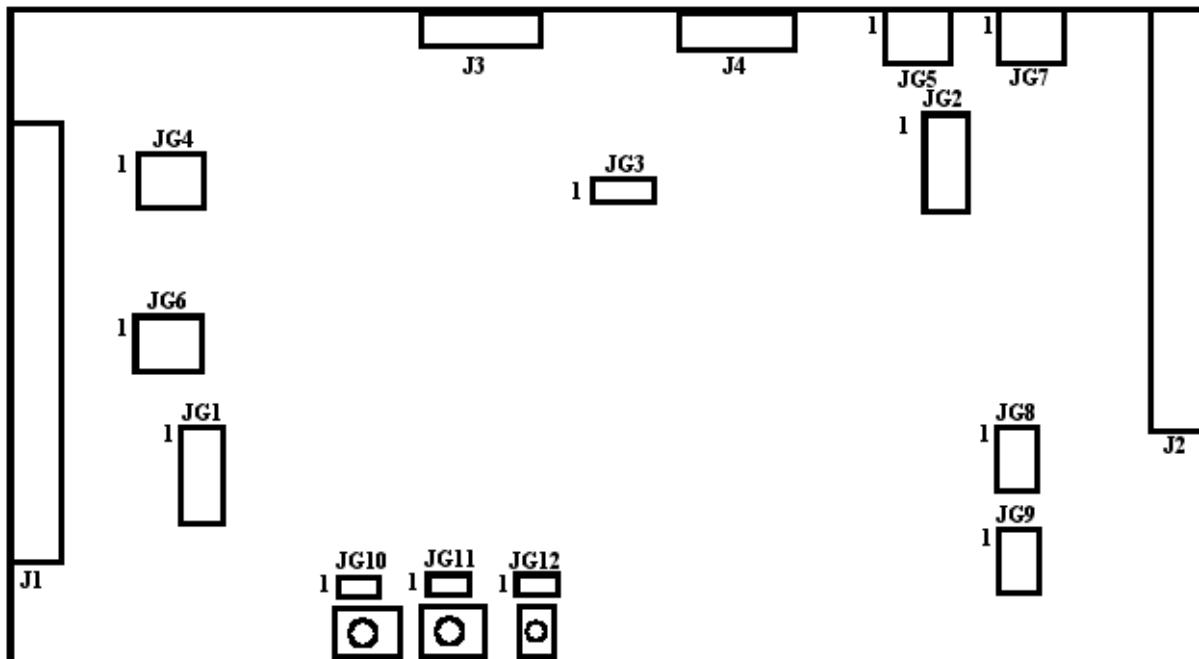


Figure 2-3 56F8300EVM - Daughter Card Jumper Reference

Table 2-1 56F8300EVM Daughter Card Jumper Settings

Jumper Group	Comment	Connections
JG1	Primary PFC	1-2, 3-4, 5-6, 7-8, 9-10
JG2	Secondary PFC	NC
JG3	Phase_IS / Over_I	1-2
JG4	Primary Zero-Crossing / Encoder	2-3, 5-6, 8-9
JG5	Secondary Zero-Crossing / Encoder	NC
JG6	Primary Back-EMF / Phase-IS	1-2, 4-5, 7-8
JG7	Secondary Back-EMF / Phase-IS	NC
JG8	Fault A Monitor	1-2, 3-4, 5-6
JG9	Fault B Monitor	1-2, 3-4, 5-6
JG10	Switch 1	1-2
JG11	Switch 2	1-2
JG12	Switch 3 (Run / Stop)	1-2

Note: When running the EVM target system in a stand-alone mode from Flash, in the 56F8346EVM, the JG9 jumper must be set in the 1-2 configuration to disable the command converter parallel port interface. In the 56F8357EVM or 56F8367EVM, the JG3 jumper must be set in the 1-2 configuration to disable the command converter parallel port interface.

3. Build

When building the Digital PFC Application, the user can create an application that runs from internal Flash or External RAM. To select the type of application to build, open the *Digital_PFC.mcp* project and choose the target build type; see [Figure 3-1](#). A definition of the projects associated with these target build types may be viewed under the *Targets* tab of the project window.

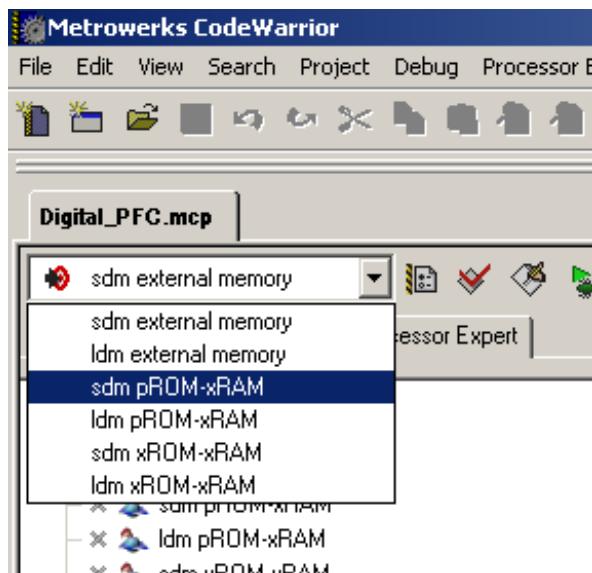


Figure 3-1 Target Build Selection

The project may now be built by executing the *Make* command, as shown in **Figure 3-2**. This will build and link the Digital PFC Application and all needed Metrowerks and Processor Expert libraries.

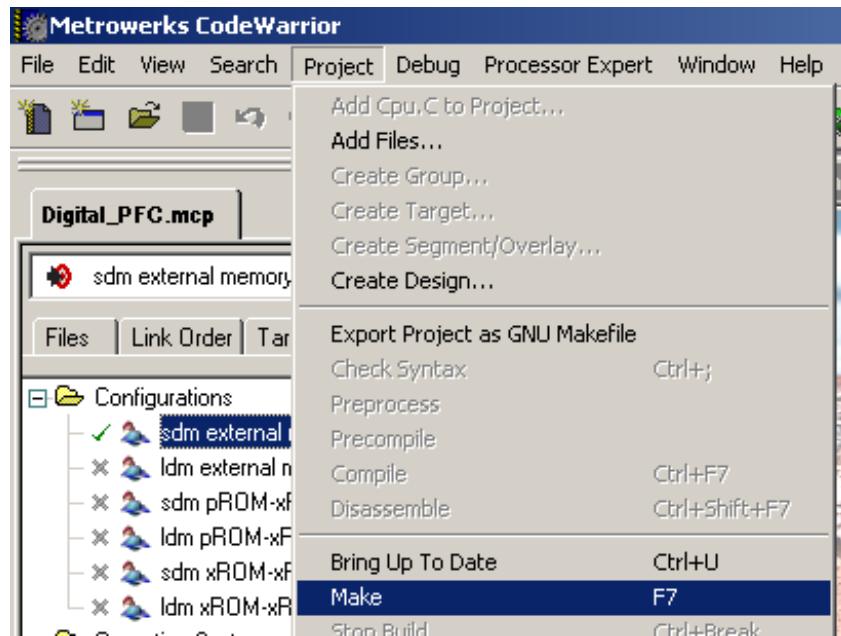


Figure 3-2 Execute Make Command

For more information about these commands, see:

<...>\CodeWarrior Manuals\PDF\Targeting_56800E.pdf

4. Projects Files

The Digital PFC application is composed of the following files:

- ...\\Project Directory\\“Project File Name”.mcp, application project file
- ...\\Project Directory\\“Project File Name”.pe, Processor Expert software file
- ...\\Project Directory\\“Project File Name”.G_C, Processor Expert software file
- ...\\Project Directory\\“Project File Name”.dsk, Processor Expert software file
- ...\\Project Directory\\bin*.xMAP, map file
- ...\\Project Directory\\bin*.elf, standard binary file
- ...\\Project Directory\\startup*.c, *.h, *.asm, initialization files
- ...\\Project Directory\\Code\\adcPrimary.* files generated by the PE for *adcPrimary* bean
- ...\\Project Directory\\Code\\PC_M1.*, files generated by the PE for *PC_M1* bean
- ...\\Project Directory\\Code\\tiAux.*, files generated by the PE for *tiAux* bean
- ...\\Project Directory\\Code\\tmrD1.*, files generated by the PE for *tmrD2* bean
- ...\\Project Directory\\Code\\Cpu.*, files generated by the PE for the CPU used
- ...\\Project Directory\\Code\\Events.*, files generated by the PE for events
- ...\\Project Directory\\Code\\PE_Const.*, PE internal definitions of the constants
- ...\\Project Directory\\Code\\PE_Error.*, PE internal definitions of the error constants
- ...\\Project Directory\\Code\\PE_Types.*, PE internal definitions of the types
- ...\\Project Directory\\Code\\PESL.*, configuration file for PESL library
- ...\\Project Directory\\Code\\Vectors.*, definitions of the interrupt vectors

5. Execute

To execute the Digital PFC Application, select the *Project/Debug* command in the CodeWarrior IDE, followed by the *Run* command. For more help with these commands, refer to the CodeWarrior tutorial documentation in the following file, located in the CodeWarrior installation directory:

<...>\CodeWarrior Manuals\PDF\Targeting_56800E.pdf

If the Flash target is selected, CodeWarrior will automatically program the device's internal Flash with the executable generated during *Build*. If the External RAM target is selected, the executable will be loaded to off-chip RAM.

Once Flash has been programmed with the executable, the EVM target system may be run in a stand-alone mode from Flash. To do this, set the JG9 jumper on the 8346EVM and JG3 on the 56F8357EVM or 56F8367EVM in the 1-2 configuration to disable the parallel port, and press the RESET button.

To enable the PFC conversion, set the RUN/STOP switch to the RUN position. If this switch was in the RUN position before the application started, move it to the STOP position first, then back to the RUN position. The USER LED should light continuously when the PFC conversion is enabled. To disable the PFC conversion, move the RUN/STOP switch to the STOP position, causing the USER LED to blink again.

How to Reach Us:

Home Page:
www.freescale.com

E-mail:
support@freescale.com

USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064, Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

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Asia/Pacific:

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Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

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